Geometry 3-1 Study Guide: Lines and Angles (pp 146-148)

Are You Ready Chapter 3 Pretest & skills.

<u>Attendance Problems.</u> Identify each of the following.

1. Points that lie in the same plane

2. Two angles whose sum is 180°

3. The intersection of two distinct intersecting lines.

4. A pair of adjacent angles whose non-common sides are opposite rays.

- I can identify parallel, perpendicular, and skew lines.
- I can identify the angles formed by two lines and a transversal.

Vocabulary		
parallel lines	perpendicular lines	skew lines
parallel planes	transversal	corresponding angles
alternate interior angles	alternate exterior angles	same-side interior angles

<u>Common Core</u>: **CC.9-12.G.CO.1** Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the un-defined notions of point, line, distance along a line, and distance around a circular arc.

In the previous chapters, you examined vertical angles and found that they are always equal . Today you will look at another special relationship that guarantees angles have equal measures.

Line *l*: Look out! You almost inter- sected me!
Line *m*: Well, *skew's* me!

"Life, loathe it or ignore it, you can't like it." -- Marvin the paranoid android

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Use the following information to answer questions 5-8. Examine the diagrams. For each pair of angles marked, quickly decide what relationship their measures have. Your response should be limited to one of three relationships: same (equal measures), complementary (have a sum of $90°$), and supplementary (have a sum of $180°$).

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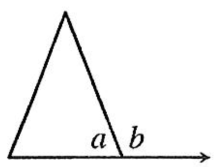

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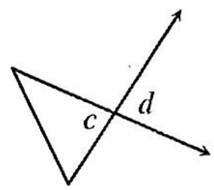

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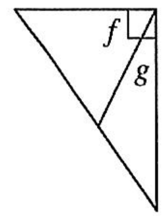

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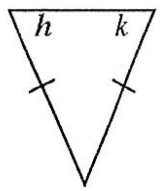
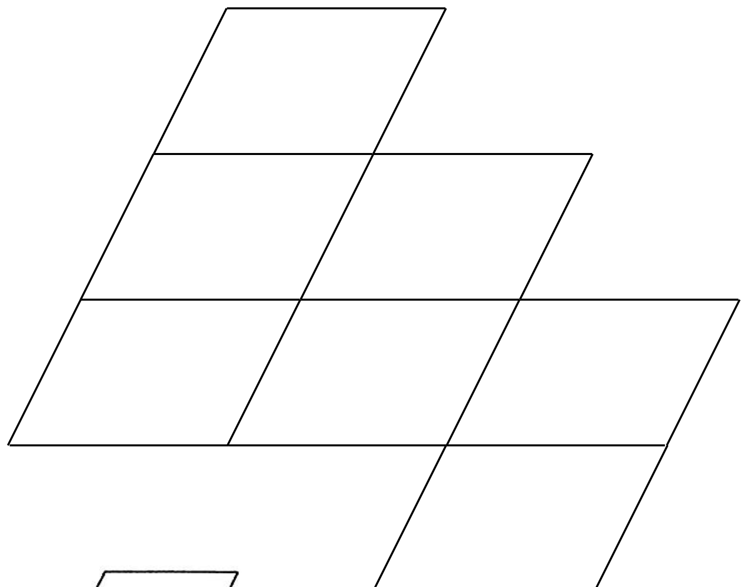


Refer to the powerpoint on the website (http://watertowngeometry.wikispaces.com/Unit+3)

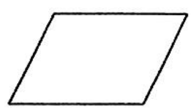
Use the following information to answer questions 9-11. Marcos was walking home after school thinking about special angle relationships when he happened to notice a pattern of parallelogram tiles on the wall of building. Marcos saw lots of special angle relationships in this pattern, so he decided to copy the pattern into his notebook.

The beginning of Marcos' diagram is shown. This type of pattern is called a *tiling*. In this tiling, a parallelogram is copied and translated to fill an entire page without gaps or overlaps.



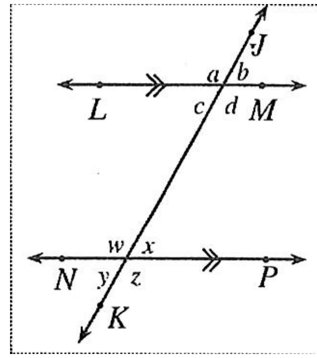
9. Since each parallelogram is a translation of another, what can be stated about the angles in the rest of Marcos' tiling? Use sketchpad to determine which angles must have equal measure. Color all angles the must be equal the same color.

10. Consider the angles inside a single parallelogram. Which angles must have equal measure? How can you justify your claim?



11. What about the relationship between the lines? Can you identify any lines that must be parallel? Mark all the lines on your diagram with the same number of arrows to show which lines are parallel.

Use the following information to answer questions 12-14. Julia wants to learn more about the angles in Marcos' diagram and has decided to focus on just part of his tiling. An enlarged view of the section is shown with some points and angles labeled.



12. A line that crosses two or more other lines is called a **transversal**. In Julia's diagram, which line is a transversal? Which lines are parallel?

13. Shade $\measuredangle x$ on your diagram. Which angle in the diagram on the same side of the transversal corresponds and has the same measure as $\measuredangle x$?

14. In this diagram, $\measuredangle x$ & $\measuredangle b$ are called **corresponding angles** because they are in the same position at two intersections of the transversal. What is the relationship between the measures of $\measuredangle x$ & $\measuredangle b$? Explain how you know.

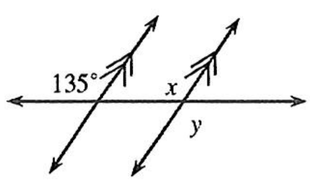
Use the following information to answer questions 15 & 16. The corresponding angles in problems 12-14 have equal measures because they were formed by translating a parallelogram.

15. Name all other pairs of corresponding angles you can find in Julia's diagram from problems 12-14.

16. Suppose $b = 60°$. Use what you know about vertical, supplementary and corresponding angle relationships to find the measures of all other angles in Julia's diagram.

Use the following information to answer questions 17-23. Frank wonders whether corresponding angles *always* have equal measures. Use tracing paper to to decide if corresponding angles have equal measure. Then determine if you have enough information to the find the measures of *x* and *y*. If you do, find the angle measures and state the relationship.

17.



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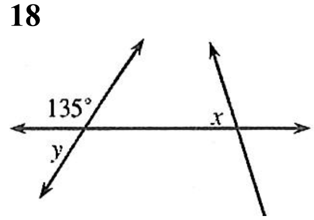

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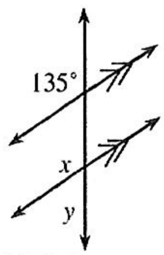

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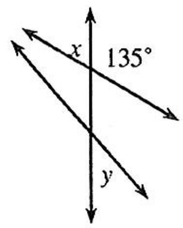


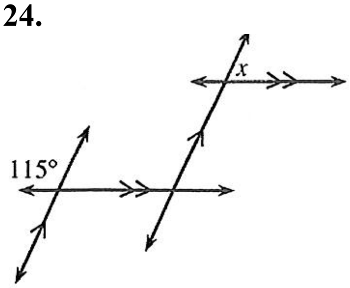
21. Answer Frank's question: Do corresponding angles always have equal measure? If not, when are their measures equal?

22. Conjectures are often written in the form, *"If . . ., then . . ."*. Make a conjecture about corresponding angles by completing this conditional statement: *"If . . ., then corresponding angles have equal measure."*

23. Prove that your conjecture in problem 22 is true. That is explain why this conjecture is a theorem.

Use the information to answer questions 24-26. For each diagram, find the value of *x*, *if possible*. If it is not possible, explain how you know. State the relationship you use. Be prepared to justify every measurement you find to other members of your table.

24.



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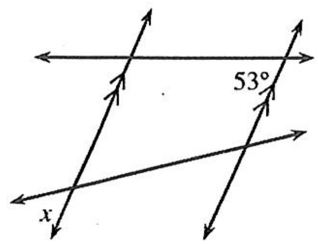

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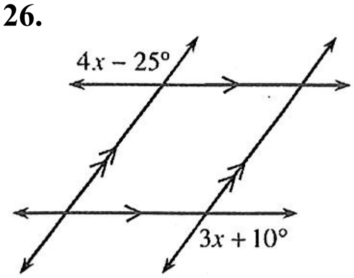

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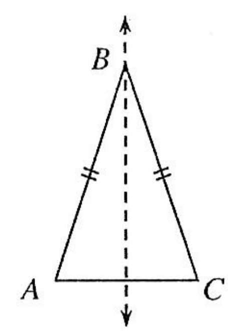
In the first part of the lesson, you looked at corresponding angles formed when a transversal intersects tow parallel lines. In the second part of the lesson, you will investigate other special angle relationships formed in this situation.

Refer to the following information to answer questions 27 & 28: Whenever one geometric figure can be translated, rotated, or reflected (or a combination of these) so that it lies on top another, the figures must have the same shape and size. When this is possible, the figures are said to be congruent and the symbol $\cong$ is used to represent the relationship.

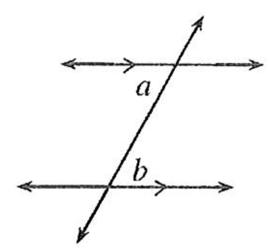
27. Review the angle relationships you have studied far. Which type of angles must be congruent?

28. Angles are not the only typed of figure that can be congruent. For example, sides of a figure can be congruent to another side. Also, a complex shape (such as a trapezoid) can be congruent to another if there is a sequence of rigid transformations that carry it onto the other.

Consider an isosceles triangle, like the one shown. Because of its **reflection (also called line) symmetry**, which parts must be congruent? State each relationship using symbols.



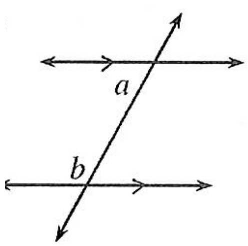
29. Suppose $\measuredangle a$ in the diagram measures $48°$. Use what you know about vertical, corresponding and supplementary angle relationships to find the measure of $\measuredangle b$.



Use the following information to answer questions 30-32. Julia is still having trouble seeing the angle relationships clearly in the diagram. Her teammate, Althea explains, *"When I translate one of the angles along the transversal, I notice its image and the other given angle are a pair of vertical angles. That way, I know that angles a and b must be congruent."*

Use Altheas' method and tracing paper to determine if the following angle pairs are congruent or supplementary. Be sure to state whether the pair of angles created after the translation are vertical angles or form a linear pair. Be ready to justify your answer for the class.

30.



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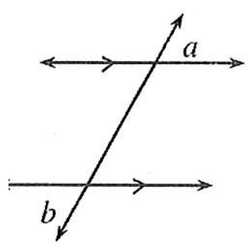

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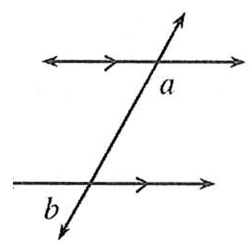
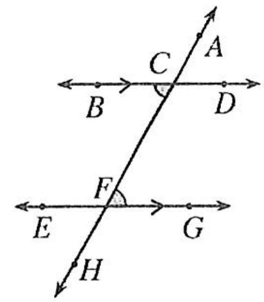


Use the following information to answer questions 33-36: In problems 29-32, Althea showed that the shaded angles in the diagram are congruent. However, these angles also have a name for their geometric relationship (their relative positions on the diagram) These angles are called *alternate interior* angles. They are called "alternate" because they are on both sides of the transversal and "interior" because they are both inside (that is, between) the parallel lines.



33. Find another pair of alternate interior angles in this diagram.

34. The about the relationship between the measures of alternate interior angles. If the lines are parallel, are they always congruent? Are they always supplementary? Complete the conjecture, *"If lines are parallel, then alternate interior angles are . . ."*

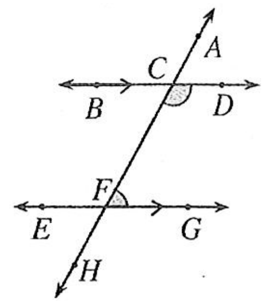
35. Instead of writing conditional statements, Roxie likes to write **arrow diagrams** to express her conjectures. She expresses the conjecture from problem 30 as:

Lines are parallel $\rightarrow$ *alternate interior angles are congruent.*

This arrow diagram says the same thing as the conditional statement you wrote in problem 30. How is it different from your conditional statement? What does the arrow mean?

36. Prove that alternate interior angles are congruent. That is, how can you use rigid transformations to move $\measuredangle CFG$ so that it lands on $\measuredangle BCF$? Explain. Be sure that everyone at your table agrees.

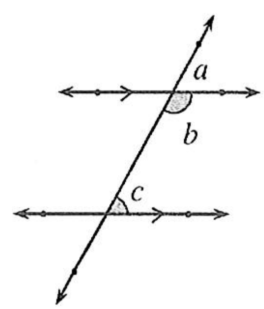
Use the following information to answer questions 37-40. The shaded angle in the diagram have another special angle relationship. They are <u>same-side interior</u> angles.



37. Why do they think they have this name?

38. What is the relationship between the angle measures of same-side interior angles? Are they always congruent? Supplementary? Talk about this with your table. Then write a conjecture about the relationship. Your conjecture should be in the form of a conditional statement or an arrow diagram. If you write a conditional statement, it should begin, *"If lines are parallel, then the same-side interior angles are . . ."*

39. Claudio decided to prove the theorem this way. He used letters in his diagram to represent the measures of angles. Then, he wrote $a + b = 180°$ & $a = c$. Is he correct? Explain why or why not.



40. Finish Claudio's proof to explain why same-side interior angles are always supplementary whenever lines are parallel.

Use the following information to answer questions 41-44: You know enough about angle relationships now to start analyzing how light bounces off mirrors. Examine the two diagrams. Diagram A shows a beam of light emitted from a light source at A. In Diagram B, someone has placed a mirror across the light beam. The light beam hits the mirror and is reflected from its original path.

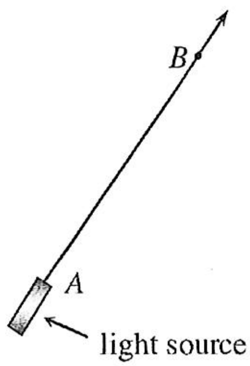


Diagram A

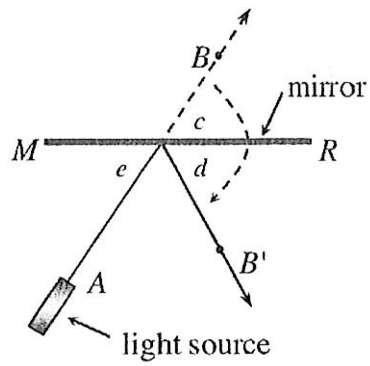


Diagram B

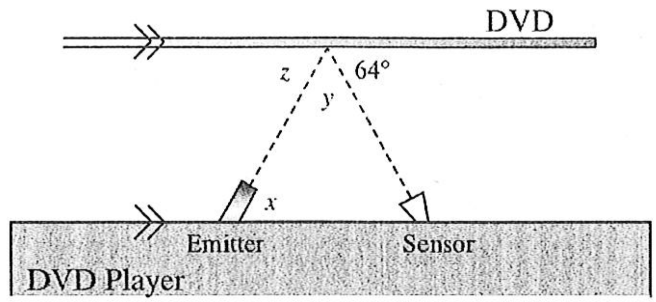
41. What is the relationship between angles *c* and *d*? Explain how you know.

42. What is the relationship between angles *c* and *e*? Explain how you know.

43. What is the relationship between angles *e* and *d*? Explain how you know.

44. Use your conclusions from questions 41-43 to prove that the measures of the angle at which light hits a mirror (angle of incidence) equals the measure at which it bounces off the mirror (angle of reflection.)

Use the following information to answer questions 45 & 46: A DVD player works by bounding a laser off the surface of the DVD, which acts like a mirror. An emitter sends out light, which bounces off the DVD and then is detected by a sensor. The diagram shows a DVD held parallel to the surface of the DVD player, on which an emitter and a sensor are mounted.



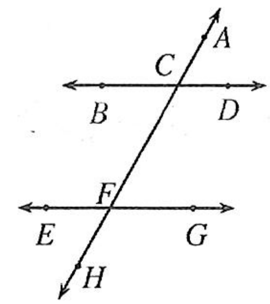
45. The laser is supposed to bounce off the DVD at a $64°$ angle as shown in the diagram. For the laser to go directly to the sensor, at what angle does the emitter need to send the laser beam? In other words, what does the measure of angle x have to be? Justify you conclusion.

46. The diagram shows two parts of the laser beam: the one coming out of the emitter and the one that has bounced off the DVD. What is the angle $(\measuredangle y)$ between the two beams?

47. <u>Angle Relationships</u>. In the diagram, describe what you know about these geometric angle relationships. Be sure to include what you know about the relationship of their angle measures (such as are they ever supplementary? If so, when?) Include a diagram.

Vertical Angles	**Straight Angles**
Corresponding Angles	**Alternate Interior Angles**
Same-Side Interior Angles	

Use the following information to answer question 48 & 49: Looking at the diagram, John says that $m\measuredangle BCF = m\measuredangle EFH$.

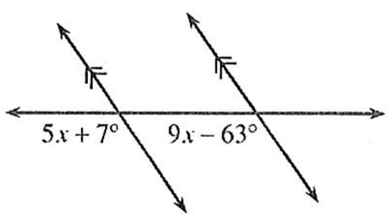


48. Do you agree with John? Explain why or why not.

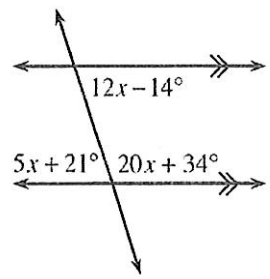
49. Jim says, *"You can't be sure those angles are equal. An important piece of information is missing from the diagram!"* What is Jim talking about?

Use the following information to answer question 50 & 51: Use your knowledge of angle relationships to solve for x in the diagram. Justify you solution by naming the geometric relationship.

50.



51.



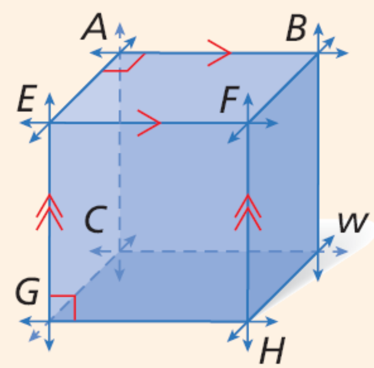
Parallel, Perpendicular, and Skew Lines

Parallel lines ($\parallel$) are coplanar and do not intersect. In the figure, $\overleftrightarrow{AB} \parallel \overleftrightarrow{EF}$, and $\overleftrightarrow{EG} \parallel \overleftrightarrow{FH}$.

Perpendicular lines ($\perp$) intersect at 90° angles. In the figure, $\overleftrightarrow{AB} \perp \overleftrightarrow{AE}$, and $\overleftrightarrow{EG} \perp \overleftrightarrow{GH}$.

Skew lines are not coplanar. Skew lines are not parallel and do not intersect. In the figure, $\overleftrightarrow{AB}$ and $\overleftrightarrow{EG}$ are skew.

Parallel planes are planes that do not intersect. In the figure, plane *ABE* $\parallel$ plane *CDG*.



Arrows are used to show that $\overleftrightarrow{AB} \parallel \overleftrightarrow{EF}$ and $\overleftrightarrow{EG} \parallel \overleftrightarrow{FH}$.

Helpful Hint

Segments or rays are parallel, perpendicular, or skew if the lines that contain them are parallel, perpendicular, or skew.

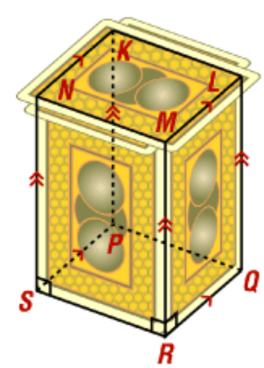
<u>Video Example 1</u>. Identify each of the following.

A. A pair of parallel segments

B. A pair of skew segments

C. A pair of perpendicular segments.

D. A pair of perpendicular planes



1 Identifying Types of Lines and Planes

Identify each of the following.

A **a pair of parallel segments**

$\overline{KN} \parallel \overline{PS}$

B **a pair of skew segments**

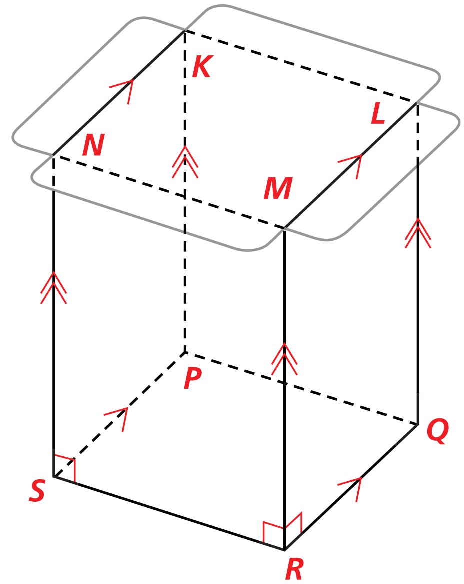
$\overline{LM}$ and $\overline{RS}$ are skew.

C **a pair of perpendicular segments**

$\overline{MR} \perp \overline{RS}$

D **a pair of parallel planes**

plane $KPS \parallel$ plane LQR



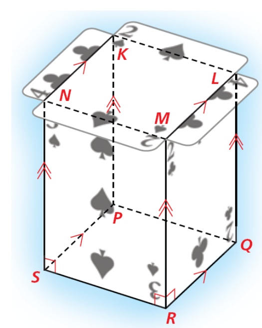
Example 1. Identify each of the following.

A. A pair of parallel segments

B. A pair of skew segments

C. A pair of perpendicular segments.

D. A pair of parallel planes

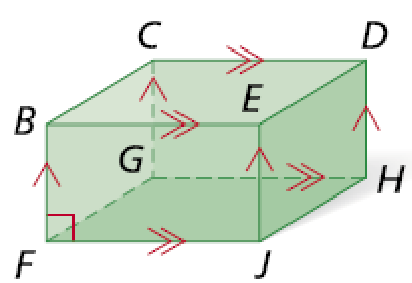


Guided Practice: Identify each of the following.

52. A pair of skew segments

53. A pair of perpendicular segments.

54. A pair of parallel planes



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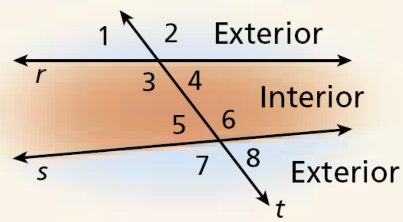
Angle Pairs Formed by a Transversal

TERM	EXAMPLE
A **transversal** is a line that intersects two coplanar lines at two different points. The transversal *t* and the other two lines *r* and *s* form eight angles.	
Corresponding angles lie on the same side of the transversal *t*, on the same sides of lines *r* and *s*.	$\angle 1$ and $\angle 5$
Alternate interior angles are nonadjacent angles that lie on opposite sides of the transversal *t*, between lines *r* and *s*.	$\angle 3$ and $\angle 6$
Alternate exterior angles lie on opposite sides of the transversal *t*, outside lines *r* and *s*.	$\angle 1$ and $\angle 8$
Same-side interior angles or *consecutive interior angles* lie on the same side of the transversal *t*, between lines *r* and *s*.	$\angle 3$ and $\angle 5$

Helpful Hint

To determine which line is the transversal for a given angle pair, locate the line that connects the vertices.

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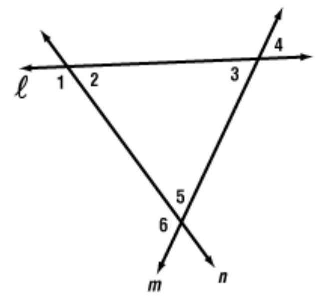
<u>Video Example 3</u>. Identify the transversal and classify the angle pair.



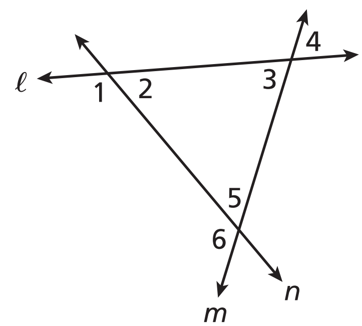
A. <2 & <6

B. <4 & <6

C. <2 & <3

3 Identifying Angle Pairs and Transversals

Identify the transversal and classify each angle pair.



A **∠1 and ∠5**

transversal: *n*; alternate interior angles

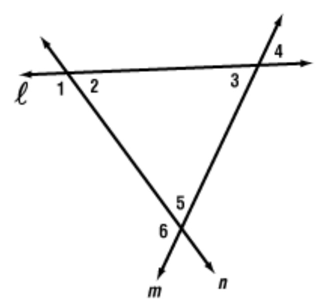
B **∠3 and ∠6**

transversal: *m*; corresponding angles

C **∠1 and ∠4**

transversal: ℓ; alternate exterior angles

<u>Example 3</u>. Identify the transversal and classify the angle pair.

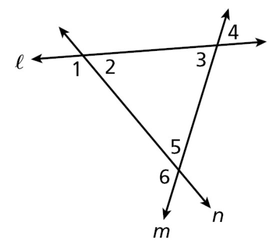


A. <1 and <3

B. <2 & <6

C. <4 & <6

55. Guided Practice: Identify the transversal and classify the angle pair <2 and <5 in the diagram.



<u>3-1 Lines and Angles</u> *(p 149)* 15-25 odd.